Port-Orford Risk Assessment
Tom Atzet, Southwestern Oregon Ecologist

Social and Economic Analysis of Port-Orford-Cedar
Rick Barnes

PERSPECTIVES OF A WATERSHED A CASE STUDY OF THE WILLIAMS PORT-ORFORD CEDAR MANAGEMENT PROJECT
Frank Betlejewski, Bureau of Land Management, Medford, Oregon

Public Concerns Regarding Port Orford Cedar Management, High Plateau Case Study
Laura Chapman, Forest Planner, Six Rivers National Forest, California

Cone and Seed Production in a Port-Orford-Cedar (*Chamaecyparis lawsoniana*) Containerized Orchard
Leslie Elliott and Richard A. Sniezko, USDA Forest Service, Dorena Genetic Resource Center, Cottage Grove, OR 97424

REASONS FOR GROWING PORT ORFORD CEDAR ON NIPF OWNERSHIPS
Ralph E. Duddles, Coos County OSU Extension Service

A Coastal Dune Port-Orford-Cedar Community
John A. Christy and Michael Murray, Oregon Natural Heritage Program

Greens and Other MarketsAbstract
Jay Esperance, Gold Beach Ranger District, Siskiyou National Forest

ROAD AND PEOPLE MANAGEMENT AS PART OF A PORT-ORFORD-CEDAR ROOT DISEASE STRATEGY
Donald J. Goheen, Plant Pathologist/Entomologist, Southwest Oregon Forest Insect and Disease Service Center

TESTING PORT ORFORD CEDAR FOR RESISTANCE TO PHYTOPHTHORA LATERALIS
Everett Hansen, Oregon State University, Corvallis
Richard Sniezko, USDA Forest Service, Dorena Tree Improvement Center

Large Woody Debris in SE Coastal Streams
Bruce Hansen, USDA, Forest Service, PNW Research Station, Corvallis.

MANAGING PORT ORFORD CEDAR AND THE INTRODUCED PATHOGEN, *PHYTOPHTHORA LATERALIS*
Everett M. Hansen, Oregon State University;
Donald J. Goheen, USDA Forest Service;
Erik S. Jules, University of California
Santa Clara; Barbara Ullian, Siskiyou Regional Education Project

***A HEALER: PORT-ORFORD-CEDAR* ITS SACRED STATURE AMONG TRIBES AND AMERICAN INDIAN SPIRITUAL PRACTITIONERS**
Nolan Colegrove, Hoopa Tribe
Kathy Heffner McClellan, Six Rivers National Forest

Port-Orford-cedar Root Disease, History of Spread and Impact,
John T. Kliejunas, USDA Forest Service, Pacific Southwest Region

Relationship of Rare Plants to Port-Orford-cedar Communities
Lisa D. Hoover, Six Rivers National Forest
Julie Nelson, Shasta-Trinity National Forest
Maria Ulloa-Cruz, Siskiyou National Forest

Developing a Conservation Strategy for Port-Orford-cedar (*Chamaecyparis lawsoniana*) Using Risk Analysis and Inventory at Various Scales
Screening Port-Orford-Cedar For Resistance To *Phytophthora lateralis*: results from 7000+ trees using a branch lesion test
Bower, A. D.[1], Casavan, K.[2], Frank, C.[3], Goheen, D.[4], Hansen, E.[5], Marshall, K.[4], Sniezko, R.[1], Sutton, W[5].

The Importance of Snags and Logs In Port-Orford-cedar Stands
Thomas M. Jimerson, Ph.D., Area Ecologist for Northern California, U.S. Forest Service

Characteristics of Snags and Logs in Port-Orford-cedar Stands
Thomas M. Jimerson, Ph.D, Area Ecologist for Northern California, U.S. Forest Service

Distribution, characteristics, and ecology of Port-Orford-cedar
Donald B. Zobel, Department of Botany and Plant Pathology, Oregon State University

---

Port-Orford Risk Assessment

Tom Atzet

Southwestern Oregon Ecologist

Without controlled experimentation, quantification of the risk Port-Orford-cedar root rot poses is difficult to obtain. At least, thirty-five factors including physical, biological, operational and political can be listed as influencing the rate of spread of the root pathogen. Careful monitoring of management activities, and analysis of ecological requirements can help estimate relative risk. While quantifying the contribution of specific risk factors is a long-term goal, We still need to explore ways to deal with the current situation. A four-part risk assessment process analyzing value, hazard, susceptibility and exposure is used as a foundation for evaluating a general strategy dealing with risk in a social context.

Social and Economic Analysis of Port-Orford-Cedar

Rick Barnes

This study takes an indepth look at the history of POC markets during the 1990's. The study looks at the standing inventory of POC on public lands. It also looks at the domestic and export markets of POC logs and lumber, as well as the markets for POC arrow shafts, boughs, and miscellaneous products. The economic impacts of POC to the regional economy is also explored.

Standing inventories of POC on public lands is estimated to be 1,154 million board feet. Of this volume, 806 million is on lands outside of wilderness areas and other Congressionally set-aside lands. The Northwest Forest Plan greatly reduces the amount of POC to be harvested. POC is commonly found in riparian areas which allow for little harvest activity in the Riparian Reserves designated in the President's Forest Plan.

Approximately 60 million board feet of POC was exported annually from the United States in the early 60's. There has been a steady decline in the volume exported. In the 1990's, the export volumes were approximately 11 million board feet early in the decade and have decreased to approximately 2 million board feet in the latter part of the decade. During the 1990's, the value of POC exported has gone from approximately 29 million dollars in 1990 down to 6.5 million dollars in 1997. The trend of domestic use of POC has been just the opposite of export volume. Logs processed domestically has steadily increased during the 1990's from approximately 2.5 million board feet in 1990 up to 6.5

increased from 1.6 million dollars in 1990 to 5.4 million dollars in 1998.

POC specialty products are highly desired for many uses. POC's unique strength, bending, and grain characteristics have created a worldwide demand for POC arrow shafts. Currently there are approximately 2.5 million POC arrow shafts manufactured each year.

POC boughs are also very popular in the floral industry. Collecting and manufacturing products from boughs is a year around business POC boughs are often placed in a glycerine compound with various colors of dye. This compound is drawn through the plant's vascular system, effectively preserving and dying the boughs. Value is also added by arranging boughs into fresh and preserved wreaths, garlands, and greens. The specialty products generate at least 1.5 million dollars of value in the POC region each year.

Employment related to POC has dropped from approximately 255 jobs early in the decade to 166 jobs in 1997. This is significant as many of the counties in the POC region have unemployment rates double the United States average. The total contribution of POC to the regional economic base is approximately 14 million dollars annually.

About the Author

Rick Barnes, President of Barnes and Associates, Inc., was the lead author. BS in Forest Management, Oregon State University, MBA in Business Administration, Southern Oregon State College. Rick has experience in both the acquisition and marketing of POC logs since 1980.

PERSPECTIVES OF A WATERSHED

A CASE STUDY OF THE WILLIAMS PORT-ORFORD CEDAR MANAGEMENT PROJECT

Frank Betlejewski

Bureau of Land Management, Medford, Oregon

As a community, Williams, Oregon has three important social segments: old-timers, alternative lifestyle, and newcomers. Old-timers are still involved in the traditional agricultural and logging activities in the valley, but are not in leadership positions. Their attitudes are generally positive or neutral about Bureau of Land Management (BLM) activities in their area. The alternate lifestyle residents are “back to the landers”, who began to settle in the Williams valley in the 1970s. They believe that human management than risk more harm. Newcomers, primarily seniors and early retirees, have moved to Williams in the last ten to fifteen years. Newcomers are typically ex-urbanites, have strong environmental values, but have little knowledge of southern Oregon ecology (Priester, 1997).

The purpose of the Williams Port-Orford Cedar Management Project was to operationally evaluate the current best known approaches for *Phytophthora lateralis* (PL) control at a small scale. The project proposal covered 308 acres. This amounts to 1.1% of the total acres administered by the BLM within the watershed (26,990 acres) and 0.6% the total acres within the watershed (51,971 acres). The project scenario was to implement a multi-faceted, integrated PL control strategy to determine biologically effective and economically efficient techniques that could be utilized at a watershed (landscape) level approach to Port-Orford cedar (POC) and PL management.

The following is not a scientifically designed survey of the community of Williams regarding Port-Orford cedar management. It is a compilation of comments from a total of 45 letters, faxes, newspaper articles, and phone conversation records from the local watershed council, town council, environmental groups, the timber industry, the Applegate Partnership, and private individuals. These were submitted between September 12, 1996 and December 17, 1998. A total of 343 specific comments were placed into 17 categories for the purpose of this analysis.

Of the comments received, the majority (217 or 63%) fell into 5 categories:

1.Forest Management	(64)
2.Tie: Roads	(50)
Science	(50)
3.Fisheries	(28)
4.Risk	(25)
	217

The Williams Port-Orford Cedar Management Project responds to these and other issues.

Public Concerns Regarding Port Orford Cedar Management

High Plateau Case Study

Laura Chapman - Forest Planner, Six Rivers National Forest, California

The Six Rivers National Forest has been implementing a number of measures to prevent the spread of Port Orford cedar root disease. The most controversial of these measures is the gating of roads, and nowhere on the Forest has gating been more controversial than in the High Plateau area within the North Fork of the Smith River. This remote and rugged area forms the largest island of uninfested watersheds in much of the Smith River basin, and it contains many unique plant communities that are associated with Port Orford cedar. High Plateau is also favored by OHV enthusiasts for its challenging roads and beautiful vistas. As a result, some publics have strongly advocated for restricting access to the area, while others want it to remain open. This study describes the public issues and concerns regarding the management of the High Plateau area, and how the Forest worked with the public to try to resolve these issues. It also discusses the how social and ecological values of Port Orford cedar were considered in developing the proposed action to prevent the spread of Port Orford cedar root disease into the area. The study concludes with a summary of the lessons learned from the process and some recommendations for future Port Orford cedar management.

ABSTRACT - Cone and Seed Production in a Port-Orford-Cedar (*Chamaecyparis lawsoniana*) Containerized Orchard

Leslie Elliott and Richard A. Sniezko

USDA Forest Service, Dorena Genetic Resource Center, Cottage Grove, OR 97424

To successfully breed Port-Orford-cedar for resistance to *Phytophthora lateralis* and produce seed for restoration and reforestation it is critical to be able to obtain cones and filled seed on a reliable basis. Since the early 1990's, the USDA Forest Service's Dorena Genetic Resource Center in Cottage Grove, Oregon, has served as the location for initial cooperative breeding efforts with the USDI Bureau of Land Management, USDA Forest Service (Region 5 and Region 6), and Oregon State University for resistance to *P. lateralis*. As part of this effort, a prototype containerized seed orchard (CSO) was established to work out protocols for seed production in Port-Orford-cedar.

Port-Orford-cedar is very amendable to flower and cone production at a young age, particularly with the application of gibberellic acid (GA_3) the summer prior to flowering. The potential of breeding Port-Orford-cedar at less than four years from seed offers a chance to increase the *P. lateralis* resistance of this species in a relatively short time period. Over the last seven years, techniques have been refined to induce prolific flowering on young Port-Orford-cedar, to complete control pollinations, to manage a containerized seed orchard (CSO), and to produce large amounts of filled seed.

pollen and seed cones and number of seed. Cone and seed yields were greater across all clones following GA_3 application. For the CSO, 98% of the cones and filled seed in 1998 came from the 44 GA_3 treated trees (versus only two percent 46 non-treated trees). Orchard cone yields were greater in 1998 than in 1997 (28,740 versus 20,559), and number of filled seed was only slightly less in 1998 (154,000 versus 177,000) even though only half as many trees had been treated with GA_3 in the second year. Over all clones, filled seed per cone averaged 8.6 in 1997 and 5.4 in 1998, while percentage filled seed was nearly identical (61.6% versus 61.7%). The top five clones (of 23 clones) produced 60% of the filled seed in 1997, while the top six clones in 1998 produced 64% of the filled seed; interestingly, none of the top five clones for seed yield in 1997 were among the top six clones in 1998 (out of 23 clones). Trees treated with GA_3 in 1996, but not in 1997, showed little residual (or carryover) effect from the 1996 treatment (low cone yield in 1998). Supplemental mass pollination increased total number of filled seed in 1997, but not the percentage of filled seed.

Results from the prototype orchard indicate that it should be possible to obtain good seed yields from relatively young trees (4 to 6 years from rooting or grafting). Trees utilized in this orchard were propagated by rooted cuttings and grafts from older trees and this may have conferred advantage in producing seed early. Further investigation will be needed to see if young trees also provide good seed yields within five years from seed. However, once sufficient resistant trees are identified it is anticipated that there will be little delay in producing seed for deployment. A seed insect (Port-Orford-cedar midge, *Janetiella siskiyou*) was found in many of the cones in 1998, further investigations will be needed to determine the potential loss of seed and factors to help mitigate the insect's damage.

In 1997 and 1998, control pollinations among unrelated parents averaged 5.2 filled seed per cone and 43.6% filled seed; yields from selfs were considerably lower (3.1 filled seed per cone, 21.8% filled seed). For these two years, bagged, unpollinated seed cones yielded only a few mature cones and seed, and none of the seed was filled. Control crosses should be feasible at a young age for most selections, although some clones may require several years of pollinations to obtain adequate seed yields for resistance evaluation.

REASONS FOR GROWING PORT ORFORD CEDAR ON NIPF OWNERSHIPS

Ralph E. Duddles Coos County OSU Extension Service

Traditionally, foresters have relied heavily on Douglas fir as the reforestation species of choice. The current outbreak of Swiss needle cast makes reliance on coastal Douglas fir questionable. Port-Orford-cedar should be considered as a viable alternative.

Why?

We are at the southern margin of the natural range of some other conifers like Sitka spruce, hemlock and red cedar, but we are in the heart of the POC range.

Port Orford cedar is a prolific seeder and regenerates easily, particularly on disturbed sites. Annual production of up to 1.8 million seeds per acre is not uncommon.

There is opportunity for intermediate income by harvesting boughs for ornamental greens.

Many NIPF owners prefer to carry their forest to rotations longer than what is common on industry lands. Market value for mature POC logs is good.

Port Orford cedar is very shade tolerant so it is often found as an understory tree. It can be grown in mixed species stands, and lends itself to uneven age management, which some woodland owners prefer.

Mixed species two story stands may produce more overall volume than even age stands.

POC is an aesthetically pleasing tree.

In summary, woodland owners should not write off Port Orford cedar because of the root disease, but should consider it as an opportunity. It can provide greater species diversity and possibly greater overall volume production. There is potential for intermediate income, and good return at final harvest. Because of its shade tolerance Port Orford cedar lends itself to uneven age management.

A Coastal Dune Port-Orford-Cedar Community

John A. Christy and Michael Murray

Oregon Natural Heritage Program

We document a unique Port-Orford-cedar community which occurs in the Oregon Dunes National Recreation Area. This association occurs on narrow, dry stabilized dune ridges, troughs and seasonally dry deflation plains at the southern end of the National Recreation Area, where less than 200 acres have been identified. Trees consist primarily of Port Orford-cedar, Douglas fir and Sitka spruce. Evergreen huckleberry dominates the shrub layer averaging 82% cover. Many large Port-Orford-cedars have charred bark, and ages of fire-sensitive trees present suggest that stands were last burned about 80-100 years ago. We found six old-growth stands; five between the Trans-Pacific Highway and Horsfall Road, and one east of Beale Lake. Droughty sand does not appear to inhibit farther inland.

Stands should be managed to avoid any possibility of accidental introduction of the root rot fungus. All stands should be protected and monitored, and all motorized vehicles should be excluded. Hiking trails or viewing platforms are not recommended, as any intrusion may inadvertently introduce the root rot.

Michael P. Murray 503-731-3070 ext. 343

Ecologist 503-230-9639(fax)

Oregon Natural Heritage Program www.heritage.tnc.org/nhp/what.html

821 SE 14th Ave., Portland, OR 97214

Greens and Other MarketsAbstract

Jay Esperance, Gold Beach Ranger District, Siskiyou National Forest

Port-Orford-cedar can provide economic values other than lumber and arrow shafts. A market does exist for POC boughs, along with Incense Cedar blooms." Bough collection can offer a boost to the economy, filling a need for floral arrangements and decorative wreaths. The bough market has a tendency to fluctuate with the seasons, with prices paid by floral sheds ranging from 0.18/lb to 0.40/lb and averaging 0.25/lb.

On the Gold Beach Ranger District, the U.S. Forest Service has entered into stewardship contracts to provide boughs to the market while maintaining control of bough collectors within the POC environment, thus reducing the spread of *Phytopthora lateralis*. Bough permits have ranged in price from 0.02/lb to 0.70/lb, currently selling for 0.065/lb.

An example of the type of requirement of these stewardship contracts includes:

Identifying crop trees at 20' x 20' spacing, removing only the lower 50% of the crown,

Allowing bough cutting to occur in the sequence from low risk areas to high risk areas, but never in reverse, and

Washing of vehicles daily, prior to entering the forest, to reduce the spread of *Phytophthora lateralis*.

We have found that with proper pruning the contractors are stimulating bough growth to double within 5 years.

Opportunities for bough management in the near future will include a 2 mile stretch along a power line right of way. This opportunity will require the contractor to maintain all POC at a 10 foot height, enabling the power company to reduce maintenance costs along the right of way.

Although we believe our contractors are in compliance with their stewardship contracts, we are finding bough theft to be moderately high. Theft may be due to lack of local law enforcement and/or compliance checks. The downside of non-compliance is not the loss of boughs, as much as the increased spread of *Phytophthora lateralis*.

ROAD AND PEOPLE MANAGEMENT AS PART OF A PORT-ORFORD-CEDAR ROOT DISEASE STRATEGY

Donald J. Goheen, Plant Pathologist/Entomologist

Southwest Oregon Forest Insect and Disease Service Center

Humans have been the main vectors of *Phytophthora lateralis*, cause of Port-Orford-cedar root disease. Long distance spread of the pathogen has resulted primarily from moving infested soil into previously disease-free sites on machinery and vehicles. Major spread has occurred via earth movement in road construction, road maintenance, mining, logging, and traffic flow on forest roads.

Clearly, minimizing or preventing spread of *P. lateralis* into yet-uninfested areas is a critical aspect of any Port-Orford-cedar root disease management strategy. Management of roads and road users is key to successfully limiting spread of the pathogen. It is not always easy to do. Techniques being used include:

1) <u>Exclusion</u> - Completely preventing vehicle entry into uninfested areas by either a) not building roads into uninfested areas where no roads yet exist or b) permanently closing roads that already occur in uninfested areas.

2) <u>Temporary Road Closures</u> - Closing roads during times of year when conditions conducive to *P. lateralis* spread are most likely to prevail (typically from October 1 to June 1 plus any especially cool moist periods during other times of the year).

3) <u>Roadside Sanitation Treatments</u> - Removing or killing Port-Orford-cedar in buffer strips along either sides of roads to either a) minimize likelihood of vehicles picking up inoculum along roads in already-infested areas or b) prevent or reduce likelihood of new infections being established along open roads in yet uninfested areas.

4) Vehicle Washing - Thoroughly cleaning vehicles and equipment to remove adhering soil before driving them into areas where healthy Port-Orford-cedar occur or moving them from *P. lateralis* infested to uninfested areas within the forest.

5) Appropriate Operations Planning, Scheduling, and Execution - Regulating forest projects and special use activities so that operations in disease free locations are separated in both space and time from work in diseased stands.

6) Integrating Disease Treatments in Road Design, Engineering, and Maintenance - Minimizing movement of infested soil in road building, upkeep, and use and, where possible, decreasing exposure of Port-Orford-cedar to roadside influences by design and location.

7) Education Efforts - Disseminating information to all forest users on the biology and ecology of *P. lateralis* with emphasis on how the pathogen spreads and how spread can be prevented; encouraging all to do what they can to prevent spread of the pathogen.

TESTING PORT ORFORD CEDAR FOR RESISTANCE TO PHYTOPHTHORA LATERALIS

Everett Hansen, Oregon State University, Corvallis

Richard Sniezko, USDA Forest Service, Dorena Tree Improvement Center

Not all cedar trees die at the same rate. When disease first appears in a stand or a hedgerow, some trees stay green for several years after neighboring trees have died, and occasionally trees survive seemingly indefinitely. Are these survivors genetically resistant to the pathogen, or are they just lucky escapes?

We have developed methods to screen for these candidate trees for resistance, established field tests of resistant trees, and the Forest Service has now initiated an operational program of breeding for resistance (to be described in the next talk). Three tests for resistance have seen extensive use.

The branch lesion test utilizes 3-foot long branches cut from the tree to be tested and inoculated by inserting the fungus into a slit in the bark. The stem lesion test also uses branch ends, now only 12 inches long. The cut ends are immersed in a suspension of the swimming zoospores of the pathogen for inoculation. The root lesion test is used on cedar seedlings. The tip ends of the roots are immersed in a zoospore suspension for 24 hours, and then the seedling is repotted. In each case, the extent of fungus growth in the roots or stem is measured after a fixed time period.

The branch lesion test was used to evaluate the first selections of candidate resistant trees. These selections came from the Coos County Forest and adjacent private lands. ``Winners" were planted at the OSU Botany Farm, on a plot of ground heavily infested with *P. lateralis*. Ten years later, the survivors are growing well, while all of the susceptible selections have suffered severe mortality. In the next round of selections, 193 live POC trees surrounded in the forest by dead trees were tested for resistance. The branch lesion test suggested that most of these trees were lucky ``escapes", and indeed many have subsequently died. Other trees had shorter lesions in the test, however, and a few supported only very limited growth after artificial inoculation. Seed was collected from 28 of the forest trees, including trees that tested resistant and susceptible and in-between. Seedlings were then planted on naturally infested sites on the Powers and Gold Beach Districts. After 5 years, the same families have the best survival at both sites.

From these experiences we conclude that:

A few forest trees have resistance to *P. lateralis* that is transmitted to their progeny.

Resistant trees can be selected more efficiently by selecting in areas where the disease has been active for some time.

Most surviving trees are escapees.

Our resistance tests are useful for detecting at least the most resistant trees.

Large Woody Debris in SE Coastal Streams

Bruce Hansen, USDA, Forest Service,

PNW Research Station, Corvallis.

Port Orford Cedar can be a major component of large woody debris in SW Oregon streams. These large key pieces are responsible for habitat complexity, channel stabilization and structure in stream channels from the mountains to the sea. Even in the ocean, LWD provides habitat and nutrition for entire pelagic food chains. In the Elk River watershed, LWD loading varies in space and time. Large wood and valley floor morphology are key predictors of fish abundance. Adjacent riparian zones have long been thought of as source areas of in-channel wood. Research from the Central Oregon coast shows 50% of the in-channel wood to be of upslope origin and delivered to the channel by landslide. Managers can use this understanding of LWD source and sink areas to influence resource decisions.

MANAGING PORT ORFORD CEDAR AND THE INTRODUCED PATHOGEN, *PHYTOPHTHORA LATERALIS*

Everett M. Hansen, Oregon State University; Donald J. Goheen, USDA Forest Service;

Erik S. Jules, University of California Santa Clara; Barbara Ullian, Siskiyou Regional Education Project

Since the 1920s *Phytophthora lateralis* has been killing Port Orford-cedar (POC) trees in the Pacific Northwest. Today it has spread throughout the native range of its host with dramatic consequences, and losses continue. Now renewed energy, new research, and environmental vigilance offer hope for reversing the decline of a valuable tree.

Port-Orford cedar, or Lawson's cypress, is the largest member of the Cypress family. It is found in the wild only in a limited area of southwest Oregon and northwest California. The disease caused by *Phytophthora lateralis* was first reported in 1923 near Seattle in nurseries growing POC for the ornamental trade. In 1952 dead cedars were first seen in the lowland forests of southwest Oregon and the disease spread into the mountains following road building and timber harvest activity in the 1960s and 1970s.

The road system in cedar country is largely infested and provides the main pathway for disease spread. The situation along streams is especially critical. Essentially all POC growing with their roots in contact with normal winter high water flows are killed within a few years of introduction of the pathogen to the stream.

The first substantial, coordinated, and sustained initiative to protect POC was instigated in 1985, not by the Forest Service but by the environmental community. A number of techniques are currently being used by the Federal agencies to minimize spread and intensification of cedar root disease. Most of the disease management effort to date has been directed at road management. Year-round road closures provide the greatest protection. In some areas vehicles and equipment are routinely washed. Sanitation aims to reduce the probability of spread and intensification by reducing inoculum loads along roads.

Since the demonstration of heritable resistance to *P. lateralis* in 1989, the POC resistance program has been gaining momentum. Richard Sniezko from the Dorena Tree Improvement Center calculated family mean resistance heritabilities as 0.21 and 0.91 for stem and root resistance tests, respectively. The earliest replicated outplanting test of trees selected at Oregon State University for resistance to *P. lateralis* is now 10 years old. Resistance to *P. lateralis* offers the best hope yet of reestablishing POC in areas where the pathogen is already established. It must be emphasized, however, that the resistance program alone offers no protection for surviving stands of POC. Efforts to halt transport of the pathogen into uninfested watersheds and to generally reduce inoculum pressure must be redoubled and sustained.

A HEALER: PORT-ORFORD-CEDAR

ITS SACRED STATURE AMONG

TRIBES AND AMERICAN INDIAN SPIRITUAL PRACTITIONERS

Nolan Colegrove, Hoopa Tribe

Kathy Heffner McClellan, Six Rivers National Forest

Port-Orford-cedar *(Chamaecyparis lawsoniana)* plays a significant role in the cultural, medicinal, and religious life of the many Tribes who inhabit its limited range in Southwestern Oregon and Northwestern California.

Historically, some Tribes lived within the deep canyons of fir and cedar canopy forests that influenced their daily lives. Other Tribes, particularly in Northern California lived with the more dominant Douglas-fir *(Pseudotsuga menziesii)* and Redwood *(Sequoia sempervirens)* forests utilizing the pockets of Port-Orford-cedar where they existed. However, the tree held the same significance in the ceremonial life of all the Tribes it touched.

Seen as a healer, every part of the Port-Orford-cedar tree was utilized.

Today only a few Tribes are managing Port-Orford-cedar, the Hoopa Valley Tribe of Northern California is one such Tribe. Their Forest Management Plan reflects and emphasizes its cultural and religious values regarding Port-Orford-cedar, as well as their concern of the *Phytophthora lateralis* fungus that is devastating this species.

There is a challenge before our communities to provide for the continued existence of the healer as an active participant in its traditional ceremonial ways and in its sacred stature on the landscape.

Port-Orford-cedar Root Disease, History of Spread and Impacts

John T. Kliejunas

USDA Forest Service, Pacific Southwest Region\

Because of its beauty, Port-Orford-cedar (POC) and its varieties were widely planted as ornamentals. The use of POC in landscape and specimen plantings, hedges, and

and British Columbia, far north of its native range.

In 1923, the Malmo Nursery near Seattle sent specimens of POC seedlings with a suspected fungus disease to the Pacific Northwest Station. In an accompanying letter, the nursery manager stated that ``it would probably be worthwhile to have a thorough study made of this disease, as if it goes unchecked, it will eventually kill all cypress, including the Lawson cypress timber stands of Oregon." Although the problem was suspected to be a disease, it would be almost 20 years before the cause was confirmed and the pathogen described.

Following this 1923 report, the pathogen spread southward in ornamental plantings of POC, largely through transport of infected nursery stock. In 1937, dying POC were noted in the Willamette Valley. As the problem increased, and affected trees were closely examined, a fungus was noted on the roots and in the soil. The pathogen was described in 1942 as a previously unidentified species, *Phytophthora lateralis*. Attempts to control the disease through destruction of seedlings and the use of fungicides were futile, and the ornamental cedar industry was largely abandoned by the early 1950s.

The disease was first reported in the native range of POC near Coos Bay, Oregon in 1952. Annual roadside surveys to monitor the spread of the pathogen in forests began that year. By 1954 the pathogen had spread along roadways and waterways along the coast and 20 miles inland. Aerial photographs taken in 1956 showed a network of dying trees along watercourses, around lakes and sloughs, and along rural roads, livestock trails, and farmsteads. In 1960, several infected POC were found on the Siskiyou National Forest. Forest road surveys in 1964,1974, 1983, and 1986 showed increasing levels of infestation. In 1980 the disease was reported at six locations in the Smith River drainage in northwestern California. Yearly surveys to follow spread of the disease in California were conducted from 1980 through 1986. In 1991, the pathogen was isolated from Pacific yew in the Six Rivers and Siskiyou National Forests. In 1996 the disease was reported at two locations in the Klamath River drainage and at one location in the Sacramento River drainage.

Impacts of the exotic pathogen have been great. In addition to the loss of the ornamental cedar industry (estimated at 0.5 to 1 million dollars/year), volume loss, costs of disease control and ecological costs have occurred. Volume loss estimates alone range from 250 million to near 1 billion dollars. Some impacts of the disease, such as its adverse effects on a unique ecosystem, are unmeasurable.

Relationship of Rare Plants to Port-Orford-cedar Communities

Lisa D. Hoover, Six Rivers National Forest, Julie Nelson, Shasta-Trinity National Forest

Maria Ulloa-Cruz, Siskiyou National Forest

Port-Orford-cedar communities support an array of rare plant species. At least 60 species considered Sensitive in Region 5 and Region 6, rare by the California Native Plant Society, or rare by the Oregon Natural Heritage Program are associated with Port-Orford-cedar communities. The information was collated using a GIS application which overlayed Port-Orford-cedar polygons with Sensitive and rare plant location data. The species associated with Port-Orford-cedar include those that occur across the range of Port-Orford-cedar and across various communities to those that are highly restricted in their distribution. For example, California pitcher plant (*Darlingtonia californica*) is relatively widespread across the range of Port-Orford-cedar, occurring in various communities. In comparison, the Federal Species of Concern large-flowered rush lily (*Hastingsia bracteosa*) only occurs in one locale within the Siskiyou Mountain subsection and the Scott Mountain phacelia (*Phacelia dalesiana*) and showy raillardella (*Raillardella pringlei*) are known only to the Lower and Upper Scott Mountain ecological subsection. Of the Port-Orford -cedar communities, the Tanoak-Port-Orford-Cedar-California Bay/Evergreen Huckleberry association supports the greatest diversity of species. Species within this association occupy habitats indicative of wet (fens, riparian) and dry (barrens) moisture conditions. Relative to the ecological subsections, the Siskiyou Mountain subsection supported the greatest diversity of species.

Range-wide Assessment of Port-Orford-cedar Plant Communities: Diversity and Gradient Analysis

Thomas M. Jimerson, Ph.D., ecologist, Six Rivers National Forest

Elizabeth A. McGee, ecologist, Six Rivers National Forest

Port-Orford-cedar (Chamaecyparis lawsoniana) is found only from coastal central Oregon to northwest California, primarily in the Coast Ranges, Siskiyou and Klamath Mountains with a small disjunct population in the Scott Mountains. Although, it has a narrow geographic distribution, it occupies many different environments from sea level to streamsides, and terraces and on mountain side-slopes from lower to upper 1/3 positions. Soils are derived from a variety of parent materials, including sandstones, schist, phyllite, granite, diorite, gabbro, serpentinite, peridotite and volcanics. They are primarily Entisols, Inceptisols, Alfisols and Ultisols included in the mesic and frigid temperature regimes and udic and xeric moisture regimes. Port-Orford-cedar also shows adaptability to a wide range of summer evapo-transpiration stress, from very high humidities along the coast to very low summer humidities inland. This great ecological amplitude of Port-Orford-cedar is believed to reflect a geographic concentration of genetically based characteristics that had developed in a larger geographic range which included parts of Idaho, Montana, California, Oregon and as far as east as Nebraska.

The environmental diversity of Port-Orford-cedar stands is exemplified by the high number of species found by layer in association with it. In the overstory tree layer alone 29 species were identified. The shrub layer included 93 species and the forb layer an amazing 446 species. Many of these tree and shrub species were identified as indicators of environment change. Direct gradient analysis using canonical correspondence analysis [CANOCO] was used as the primary tool to define the environment gradients that best explained the variability of Port-Orford-cedar communities. The analysis will be described in a stepwise manner beginning with the range wide (full data set). This initial ordination helped to identify the primary gradients influencing species composition within Port-Orford-cedar stands. Next, the data was partitioned by ecoregion/subsection in an effort to identify other variables that were affecting Port-Orford-cedar sub-series. The final partitioning involved a separate analysis of each sub-series (dependent on sufficient plot numbers) to identify the environment gradients affecting Port-Orford-cedar plant associations.

Port-Orford-cedar plant associations are key elements of the biodiversity of Southwest Oregon and Northwest California. Its plant communities display among the richest plant species diversity of all forest types in the region. Port-Orford-cedar is found in association with a wide range of species with differing ecological requirements. These species change in conjunction with the portion of Port-Orford-cedar's range in which they are found. For instance, in the northwest portion, Port-Orford-cedar is found in association with western hemlock (<u>Tsuga</u> <u>heterophylla</u>), in the southwest with coast redwood (<u>Sequoia</u> <u>sempervirens</u>) and tanoak (<u>Lithocarpus</u> <u>densiflora</u>), in the central portion Douglas-fir (<u>Pseudotsuga</u> <u>menziesii</u>), at higher elevations in the eastern portion of its range, white fir (<u>Abies</u> <u>concolor</u>), western white pine (<u>Pinus</u> <u>monticola</u>), red fir (<u>Abies</u> <u>magnifica</u> var. <u>shastensis</u>) and mountain hemlock (<u>Tsuga</u> <u>mertensiana</u>). This wide array of tree species with differing ecological requirements contributes to the high diversity of Port-Orford-cedar plant associations. Port-Orford-cedar has been noted as a component of more than ninety-three plant associations in Oregon and California.

The wide ecological amplitude of Port-Orford-cedar stands is also reflected in the climatic diversity of the

Mid-Coastal Sedimentary, Southern Oregon Coastal Mountains, Serpentine Siskiyous, Inland Siskiyous, and Coastal Siskiyou Ecoregions. In California, Port-Orford-cedar is found in the Northern Franciscan, Western Jurassic, Gasquet Mountain Ultramafics, Siskiyou Mountains, Lower Salmon Mountains, Eastern Klamath Mountains, Upper Scott Mountains, Lower Scott Mountains, Red Butte, Pelletreau Ridge, Rattlesnake Creek, and Eastern Franciscan Subsections. Port-Orford-cedar plant associations were found to have a strong relationship to selected ecoregions and subsections. These relatively uniform ecological units were mapped based on associations of their biotic and environmental factors that directly affect ecosystem function. As such they can serve as a key component of a conservation strategy for Port-Orford-cedar. Understanding the key functional components operating in each ecoregion or subsection will help us better manage for the continued existence of Port-Orford-cedar.

RECONSTRUCTING HISTORICAL SPREAD OF *PHYTOPHTHORA LATERALIS*: I. PATTERNS OF INFECTION BETWEEN POPULATIONS OF PORT ORFORD CEDAR

Erik S. Jules and Matthew J. Kauffman, Department of Environmental Studies;

University of California, Santa Cruz; Santa Cruz, CA 95064

Spread of the root pathogen, *Phytophthora lateralis* on Port Orford cedar (*Chamaecyparis lawsoniana*), is being studied at two different spatial scales: spread down individual streams and spread between streams. This paper focuses on the latter of these scales. In 1998, we began the between-stream study by constructing detailed maps of both infected and uninfected stream segments within one watershed. This watershed, the Elder Creek watershed, is within the Siskiyou National Forest in southwestern Oregon and covers ~100 km^2. The watershed varies in landscape features such as road density, cedar density, and the extent of past timber harvesting.

Stream segments were separated into distinct units we term `infection units.' Infection units are bounded at the top by roads, confluences of two streams, or the headwater boundary of a drainage. Either roads or confluences bound the bottom of the infection units. Defined in this way, each segment shares a similar fate: once the top of the infection unit is infected, the entire length of the unit is infected (or at least has inoculum load in the stream). As well, each unit can potentially be infected at a different time as compared to the units directly above or below. In particular, our project is addressing the factors that may influence the likelihood of an infection unit becoming infected or remaining healthy.

Toward this end, we recorded whether or not Port Orford cedar was infected by *Phytophthora lateralis* for each infection unit in our focal watershed. In infected units, cedar, thus allowing an assessment of how far spores may travel from roads and successfully infect individual cedars. In order to test if there is a distance between the road crossing and the first cedar which is too far for successful infection to occur, we recorded the distance to the nearest living cedar in uninfected units. Additionally, density of cedar within the first 10 m below road crossings, and within the first 50 m below road crossings were measured to test for a relationship between infection probability and the amount of cedar directly below road crossings. Likewise, the number of infected streams among the nearest 4 road crossings adjacent to each unit was measured to assess whether or not disease incidence is spatially clumped rather than randomly distributed across the study landscape.

We identified 88 stream segments in the watershed, of which 40 were infected by *P. lateralis*. Infections occurred only in the infection units downstream of a road crossing. The greatest distance spores were able to move downstream from road crossings and successfully infect cedars appears to be more than 50 m. We discuss the role that landscape characteristics we measured play in influencing the risk of infection below roads. We also describe a method of reconstructing the chronology of infections using the dendrochronology technique of cross-dating, in which the year of mortality of standing dead trees is determined by aligning climatic signatures of growth rings with those found in living cedars. We hope to use this technique to understand how landscape factors, such as road building can influence the rate of spread of *P. lateralis*.

RECONSTRUCTING LOCAL HISTORICAL SPREAD OF *PHYTOPHTHORA LATERALIS*: II. INFECTION DYNAMICS ALONG A STREAM POPULATION OF PORT ORFORD CEDAR

Matthew J. Kauffman and Erik S. Jules, Department of Environmental Studies;

University of California, Santa Cruz; Santa Cruz, CA 95064.

We describe a study that we initiated in 1998 which seeks to better understand and characterize local spread of *Phytophthora lateralis* within infected stream populations of Port Orford cedar (*Chamaecyparis lawsoniana*). The study was conducted along a 200-meter stretch of Little Elder Creek in the Siskiyou National Forest of southwestern Oregon. This work had two general components: mapping of infected and healthy trees, and dating the year of death for infected trees. We used a laser rangefinder in order to create an accurate spatial representation of the pattern of infection. Using standard surveying techniques, we mapped the stem location of all trees within the area adjacent to the stream where infection is possible, as well as the center of the stream itself. We also recorded diameter at breast height, infection symptom class, and stream characteristics, for each tree in the study.

Additionally, we took two core samples from each infected tree in the study in order to assess infection history. We used the dendrochronology method of cross-dating to determine the date of death for these infected trees. Cross-dating makes use of the shared growth response that is often found in the annual rings of trees growing in a common climate. Once the standard growth response is known, the date of mortality for dead trees can be determined by matching-up the variation in their annual rings with the known pattern from live trees. We used this technique to estimate mortality dates for all of the infected trees within our study plot, thereby reconstructing the historical spread of the disease along this section of the stream. As well, we were able to estimate the year that dead trees became infected by the dramatic reduction in growth often found in the years immediately preceding death.

Analysis of the temporal and spatial spread of the disease along this section of the stream reveal some interesting trends. This section of Little Elder Creek first became infected in 1978. Importantly, the position of cedars along the length of the stream was not a good predictor of year of infection. This is contrary to the prediction that trees upstream would be infected earlier than those located further downstream and provides insight into the scale at which spores disperse downstream. However, a tree's position alongside the stream was an important factor in determining year of infection; a clear relationship was found whereby trees nearer to the center of the stream became infected earlier than those growing farther away from the stream. As well, the time series of infection followed a maximum number of new infections in 1985 and then decreasing again in subsequent years. We posit that this pattern is due to limiting inoculum loads at the onset of infection with an increase in new infections as inoculum accumulates. These high inoculum loads are able to infect most of the trees within the infection zone such that future infections are limited by host availability.

The Future of Port Orford Cedar

Mike Lunn
Forest Supervisor, Rogue and Siskiyou NF's

ll be approaching this topic as a line officer responsible for managing a large portion of the l population of Port Orford Cedar. Probably some of the things I discuss will reinforce ier discussions that have occurred. I was struck by the remarks of Don Zobel on the first da ne session, when he talked about the Forest Service convening a meeting of interested partie o out and look around in the field, kick roads on the side of the road, and hope that everyone s away happy. I can remember a lot of those meetings myself, and while we were well-ntioned at serving the public, we often (usually) already had our minds made up and went ad with the project we had planned. When it came to timber harvests, we fully intended to g the National Forests under regulation. We intended, and our plans called for, managing e percentages of the land base to emphasize timber management and the roads that were uired by that emphasis. When I came here in 1990, shortly after the NFMA plan for the kiyou was completed, about 60% of the Forest was available for timber harvest.

in thinking about the future of Port Orford Cedar, and really the future of these National ests, the first thing I think about is the profound changes that have occurred during my nine rs here. During that time, we have clearly gone from an Agency dominated by timber rests and activities, to one where our corporate goal is ecosystem health. And this makes a nendous difference to the future of Port Orford Cedar and the overall health of these edible lands. I want to mention three areas that I think both demonstrate this and also will b ortant to POC.

ore I talk about the three areas though, I first want to acknowledge my own worst fears, and se that I believe are held by many others here in the room. It is possible that even with all th are doing, we could lose Port Orford Cedar as an integral part of many habitats within its ge, or even lose the species. It is possible. I also believe it is possible that we will not only ntain it within most of those same habitats, but also even begin restoring it in places where i been lost to the disease. Which of those possibilities come true is largely in our control.

hlights the evolution the Forest Service has gone through in the last decade in moving away
n the dominant interest as a producer of timber. Probably the first visible sign of the change
back around 1992 or so, with ``New Perspectives in Forest Management." This program,
iated by Chief Dale Robertson, was a major step away from our traditional practices of
arcutting. Efforts like Shasta Costa became national models of different ways of looking at
dscapes. The Natural Resources Agenda now lays out the following four emphases:

Forest and Rangeland Ecosystem Health
Watershed Health and Restoration
National Forest Transportation System
Recreation

se are our national policy drivers. This does not mean we will walk away from producing
s, but timber is clearly not our emphasis. We believe, and I think we can well demonstrate i
e on the Rogue and Siskiyou National Forests, that we can do the things necessary for Forest
lth, and as an outcome produce a sustainable level of timber products. That is our goal. We
continue to have some sales in matrix primarily focused on achieving our total program
ls, but by and large our sales will be intended to benefit forest and watershed health and
oration.

second major change is our Northwest Forest Plan, an outcome of the intervention by
sident Clinton to get National Forest management out of the courts and back into the woods.
s plan, which amended our two Forest plans in SW Oregon and throughout the range of the
thern spotted owl, represent the finest ecosystem management plans ever developed for land
nagement across large land areas in the world. There is nowhere that such an array of
ntific and political debate has occurred to shape how we as Americans choose to manage
se important lands. Our project level activities tier to this plan in trying to bring local
lication to an outstanding regional solution to ecosystem management, one that meets the
ds of people as well as the land. Unfortunately, it was not at all successful in getting forest
nagement out of the courts. I think we are in for another round of some kind of fixes, because
extensive litigation we face is basically making National Forest management untenable.

t, I would point out the excellent work and leadership that is going into solving the issues of
t Orford Cedar. This symposium is one example, and has highlighted many of the ongoing
rts in prevention, suppression, research, and management of the species and the root rot
ease. I have personally been extremely pleased with the focus brought to the program by
trict and Area managers of the Forest Service and BLM, and the many activities we undertal
educe spread of the disease. While several of the leaders in the program have retired, like J
lsen and Mel Greenup, I've been pleased to see a new group of folks step into their places to
mpion protection of the species. And more than that, it has truly become an institutional
us across most of its range, very much unlike what Don Zobel would have experienced back
988. Don Rose has done a lot to bring people together to combine their skills and
wledges; the attendance at this symposium exemplifies that.

other thing I think will prove to be an important tool for Port Orford Cedar is the protection c

manage large landscapes for these species in this area, Port Orford cedar will benefit becau
such a key part of many important habitats.

n closing, I still have concerns and worst fears AND I believe it is possible to maintain and
ore the species throughout its original range. The only things that are impossible are those
we choose not to do; and in nature, sometimes those happen anyway.

Silvicultural Strategies For Port-Orford-cedar Management

Eric Martz, District Silviculturist

The concern over Port-Orford-cedar (POC) root disease (Phytophthora lateralis) has managers questioning the viability of POC. The answer is dependent on desired land management objectives, and for the Powers Ranger District the answer to this is yes, because:

- POC is recognized as a significant contributor to stand diversity (shade tolerant)
- POC is often the only tree species that grows on ultramafic soils in Southwest OR and Northwest CA.
- POC can significantly improve soil fertility by incorporating calcium into serpentine soils.
- POC provides large tree structure, shade, and long lasting wood that enhances stream structures and fish habitat.
- POC is important economically.

If POC management is desired, managers are faced with the problem of how to actively manage POC with the constant threat of the *Phythopthora lateralis* root disease. To deal with this concern and to ensure the continuing presence and productivity of POC, disease control strategies were developed by the Forest Service for silviculture, timber, engineering and other forest activities. Each disease control strategy provides a base line for the continued survival of POC.

Silviculture control strategies include:

1. Identifying low risk areas
2. Planting POC singly at 25 foot spacing or in groups at 100 foot spacing; planting independently of other species; avoiding planting within 50 feet of roads, swales or other wet areas; plant container POC, certified as disease resistant
3. Using a 25 foot spacing independent of other crop trees during precommercial thinning; ensure the presence of POC by leaving it during commercial thinning operations
4. Manage POC on longer rotations and minimize management entries
5. Work with all landowners
6. Sanitize
7. Monitor

Based on monitoring, on the Powers Ranger District, the following conclusions have been reached:

1. Assure long-term commitment to follow disease control strategies. Monitoring of projects should extend past three years.
2. Combination of root disease strategies is more effective than individual strategies.
3. Planning, scheduling, and executing projects such as burning, planting, sanitization,

expenses.

4. Coordinating activities between private ownership and public agencies may be a challenge.

A Proposal for Port-Orford-cedar Management Planning On Private Forest Land

Jim Nielsen, Silviculturist

Within the broadly defined range of Port-Orford-cedar described in the Silvics of North America there are an estimated two million acres in Oregon. Private forest lands including both industrial and non-industrial size ownerships cover about 20% each of this area. This includes most of the highly productive POC habitats in the coastal zone from Port Orford to Coos Bay. Management of specific stands and tracts within this 800,000-acre area having site conditions suitable for POC is important to both the landowner and the species.

Any proposal for management of private land must consider and respect the owner's property rights. Therefore, a first step in developing a Port-Orford-cedar management plan is to determine and list landowner objectives. Among other issues, the importance to the landowner of incurring the benefits and costs of species diversity, and minimizing the impact of damaging agents such as POC root disease, Swiss Needle Cast and Black Stain Root Disease in Douglas-fir and other species, must be identified. It is also important to determine the willingness of the landowner, in specific areas, to close roads during wet weather and restrict harvest operations to dry periods.

A site specific assessment of the presence/absence of both Port-Orford-cedar and its root disease, and determination of sites suitable for the growth of POC is a vital step in developing a management plan. This can be done in part by examining cruise and harvest records and simply talking to the landowner. To do a thorough job, however, the property will need to be surveyed with current aerial photos (including field verification) provide the planner with the information needed to integrate biologic conditions with landowner objectives and site-specifically classify the ownership into one of the following alternative strategy levels:

No Treatment In this management category, either site conditions are unsuitable to the growth of Port-Orford-cedar, or landowner objectives preclude its management.

Strategy Level 1 The guiding principle behind this category is to retain or enhance the presence of POC and deal with the root disease through silvicultural measures. Planting untested or root disease-resistant stock into harvest units or other areas that either had natural POC or have conditions suitable for it is a key part of this strategy. Equally important is to avoid planting POC into sites that are at high risk of the root disease including those areas within 50 feet of roads, streams and concave wet areas. Other silviculture measures include roadside sanitation, and retention of POC in low risk locations during precommercial and commercial thinning.

Strategy Level 2 This strategy includes all of the measures in Level 1 in addition to road system level forest operation planning. Based on landowner objectives, POC and root disease presence/absence, and landowner control of road access, specific blocks of land are assigned to this category. Management measures include temporary road closures (signs, gates, barriers), timber harvest seasonal restrictions, and road construction techniques designed to minimize root disease introduction and spread. Cooperative agreements with adjacent landowners are made when feasible.

Strategy Level 3 This strategy involves landscape or ownership level forest operation planning. Basically Strategy Level 2 is implemented at a broader scale in a tract or ownership where the amount of existing POC and its habitat, including riparian areas, is very important to the total forest ecosystem.

The decisions for each tract are made and documented in a decision matrix and on larger scale maps and aerial photos. A site specific root disease control prescription is prepared based on these decisions.

Relative Risk at the Landscape Level

Don Rose, Laura Chapman, Mike Martischang, Debi Kroeger

An analysis of relative risk at the landscape scale has been completed for the Port-Orford-cedar stands on National Forest land in Oregon and California. The analysis in California was done using the plant association mapping of Port-Orford-cedar. This mapping was a combination of field observances, stand examinations, aerial photo interpretation, and formal surveys.

The mapping utilized the most current map of Port-Orford-cedar stands to determine whether they were at risk from the two primary vectors of *Phytophthora*, roads and streams. Several protection classes were identified which related to relative risk to those Port-Orford-cedar stands on the landscape utilizing topographic position, road and infection proximity, and mitigation.

2. Not in roadless or wilderness but no roads within 500 feet of any part of the stand
3. The stand was protected by a gate, barrier, or roadside sanitation
4. A mitigation measure could be implemented that would further reduce risk of infection
5. Infection source was present upstream or adjacent to the stand

Levels of accuracy between the two maps are different. Results of the analysis show that nearly 60% of the Port-Orford-cedar stands mapped in California and approximately 43% in Oregon are in a relatively low risk location in the landscape due to their distance away from existing roads or protection status behind closed gates during the wet season. Less than 10% of the mapped area in both states and in total, is or will soon be infected.

Another factor to consider is that infected stands typically do not suffer 100% mortality. Trees on microsites and away from stream channels and roads do survive even within areas shown as infected. The nature of the distribution of Port-Orford-cedar is very different between California and Oregon. Port-Orford-cedar in California is relegated to riparian habitat more frequently and is not found on upland sites as much as in Oregon. Therefore mapping of the relative risk is probably more accurate in California than the Oregon mapping. Stands in Oregon that are in upland areas may show up in the table as at risk when in fact, these stands may be fairly low risk if they are distant from roads and water sources. Therefore, the number of trees infected overall is something less than 9%.

There are additional areas available in both states that could benefit from mitigation treatments such as roadside sanitation and road management activities.

Screening Port-Orford-Cedar For Resistance To *Phytophthora lateralis*: results from 7000+ trees using a branch lesion test

Bower, A. D.[1], Casavan, K.[2], Frank, C.[3], Goheen, D.[4], Hansen, E.[5], Marshall, K.[4], Sniezko, R.[1], Sutton, W[5].

As part the process of developing an operational program breeding for genetic resistance

Phytophthora lateralis, an inter-agency effort has been undertaken to select and screen phenotypically resistant trees throughout the range of Port-Orford-cedar. The USDA Forest Service, USDI Bureau of Land Management, and Oregon State University (OSU) have selected over 7000 trees across southwest Oregon and northern California, predominantly on federal lands. Generally, these selections were healthy trees in areas where *P. lateralis* is known to be present. Screening began at OSU in 1989, and different techniques were developed and used through 1996. Operational screening of field selections began in 1997, and through 1998, over 6700 clones were been screened using the branch dip method. This method had previously been found to identify at least the most resistant clones. Lesion length was measured on 6 branches per clone, and these measurements were compared with a resistant and a susceptible control tree. Relatively few of the clones screened in 1997 and 1998 had branch lesions means smaller than the resistant control. Approximately the top 10% of each run was selected to be included in the breeding program. Over 1000 clones are currently in the breeding program, for the purposes of retesting, crossing, and archiving these genotypes. The screening effort is continuing in 1999 with many areas of private land within the range of Port-Orford-cedar being targeted for selection and testing, with an ultimate goal of screening a total of 9000 trees.

[1] USDA Forest Service, Dorena Genetic Resource Center, 34963 Shoreview Road, Cottage Grove, OR 97424

[2] USDA Bureau of Land Management, Roseburg District Office, 777 NW Garden Valley Blvd., Roseburg, OR 97470

[3] USDA Forest Service, North Zone Genetic Resource Unit, 1312 Fairlane Road, Yreka, CA 96097

[4] USDA Forest Service, SW Oregon Forest Insect and Disease Service Center, 2606 Old Stage Road, Central Point, OR 97502

[5] Oregon State University, Department of Botany and Plant Pathology, Corvallis, OR 97331

The Importance of Snags and Logs In Port-Orford-cedar Stands

Thomas M. Jimerson, Ph.D.

Area Ecologist for Northern California, U.S. Forest Service

Snags and logs are key components of wildlife habitat. Their characteristics such as species, decay class, density, diameter and height or length influence their use by wildlife. A total of 1299 plots were sampled throughout northwest California using a nested sub-plot design. Of the total plots, 149 were sampled in Port-Orford-cedar stands. These plots yielded a total of 1132 snags and 862 logs. Characteristics recorded for each snag and log, included density, species, diameter, decay class, height or length and wildlife use. Understanding the role of coarse woody debris in Port-Orford-cedar stands is particularly important in light of the ongoing mortality occurring in riparian systems due to Port-Orford-cedar root disease. This paper will describe and compare the characteristics of snags and logs in Port-Orford-cedar stands by vegetation type and species and assess their importance to wildlife. Key findings are summarized below by snag and log category.

Snags

Snag density varied by vegetation type. The Port-Orford-cedar series had a significantly higher density of large snags $\geq$ 20 inches diameter and $\geq$ 50 feet tall (3.9 acre) in comparison to the Tanoak-Port-Orford-cedar sub-series (1.9 acre). Snag species composition was primarily Port-Orford-cedar (34%), Douglas-fir (34%), white fir (11%) and various hardwoods (8%). The snag size analysis identified sugar pine as the largest snag (mean diameter of 27 inches and mean height of 86 feet). It was followed by Douglas-fir (25 inch mean diameter and 28 feet tall) and Port-Orford-cedar (20 inch mean diameter and 42 feet tall). The frequency of snags by decay class showed that Port-Orford-cedar snags were found mainly in decay class 2 (38%) and 3 (40%). It is thought that this high frequency of snags in the lower decay classes reflects Port-Orford-cedars high resistance to decay. Douglas-fir on the other hand is moderately resistant to decay and was evenly distributed throughout all decay classes. Sugar pine and white fir were found mainly in decay classes 1-3. Wildlife used sugar pine snags (cavity nesting and foraging) with a much higher frequency than all other species. Port-Orford-cedar wildlife use was relatively low.

Logs

Log density also varied by vegetation type. The Tanoak-Port-Orford-cedar sub-series had a higher density of logs $\geq$ 30 inches diameter (7.2 acre) in comparison to the Port-Orford-cedar series (4.3 acre). Log species composition was primarily Port-Orford-cedar analysis identified Port-Orford-cedar (21 inch mean diameter and 32 feet length) and Douglas-fir (22 inch mean diameter and 34 feet length) as the largest species. The frequency of logs by decay class showed that Port-Orford-cedar logs were found mainly in decay class 3 (66%) and 2 (19%). Douglas-fir was evenly distributed throughout all decay classes. Wildlife use of logs for denning and foraging was low. It appears that the most important contribution of Port-Orford-cedar logs was in the diverse structure and long-term habitat stability they provide to streams.

Characteristics of Snags and Logs in Port-Orford-cedar Stands

Thomas M. Jimerson, Ph.D

Area Ecologist for Northern California, U.S. Forest Service

Snags and logs are key components of wildlife habitat. Their characteristics such as species, decay class, density, diameter and height or length influence their use by wildlife. A total of 1299 plots were sampled throughout northwest California using a nested sub-plot design. Of the total plots, 149 were sampled in Port-Orford-cedar stands. These plots yielded a total of 1132 snags and 862 logs. Characteristics recorded for each snag and log, included density, species, diameter, decay class, height or length and wildlife use. This paper will describe and compare these characteristics by vegetation type and species and assess their importance to wildlife. Key findings are summarized below by snag and log.

Snags

Snag density varied by vegetation type. The Port-Orford-cedar series had a significantly higher density of snags $\geq$ 20 inches diameter and $\geq$ 10 feet tall (7.0 acre) in comparison to the Tanoak-Port-Orford-cedar sub-series (3.0 acre). Snag species composition was primarily Port-Orford-cedar (34%), Douglas-fir (34%), white fir (11%) and various hardwoods (8%). The snag size analysis identified sugar pine as the largest snag (mean diameter of 27 inches and mean height of 86 feet). It was followed by Douglas-fir (25 inch mean diameter and 28 feet tall) and Port-Orford-cedar (20 inch mean diameter and 42 feet tall). The frequency of snags by decay class showed that Port-Orford-cedar snags frequency of snags in the lower decay classes reflects Port-Orford-cedars high resistance to decay. Douglas-fir on the other hand is moderately resistant to decay and was evenly distributed throughout all decay classes. Sugar pine and white fir were found mainly in decay classes 1-3. Wildlife used sugar pine snags (cavity nesting and foraging) with a much higher frequency than all other species. Port-Orford-cedar wildlife use was relatively low.

Logs

Log density also varied by vegetation type. The Tanoak-Port-Orford-cedar sub-series had a higher density of logs $\geq$ 30 inches diameter (7.2 acre) in comparison to the Port-Orford-cedar series (4.3 acre). Log species composition was primarily Port-Orford-cedar (38%), Douglas-fir (39%), white fir (5%) and various hardwoods (4%). The log size analysis identified Port-Orford-cedar (21 inch mean diameter and 32 feet length) and Douglas-fir (22 inch mean diameter and 34 feet length) as the largest species. The frequency of logs by decay class showed that Port-Orford-cedar logs were found mainly in decay class 3 (66%) and 2 (19%). Douglas-fir was evenly distributed throughout all decay classes. Wildlife use of logs for denning and foraging was low. It appears that the most important contribution of Port-Orford-cedar logs was in the structure and habitat they provide to streams.

Distribution, characteristics, and ecology of Port-Orford-cedar

Donald B. Zobel, Department of Botany and Plant Pathology, Oregon State University

Port-Orford-cedar (*Chamaecyparis lawsoniana* [A. Murr.] Parl.) is a large coniferous tree that grows in southwestern Oregon and northwestern California. It has a wide altitudinal range, from sea level to 1950 m, and grows on a wide variety of soils. Even so, its distribution is spotty and it is usually a component of mixed forest. It reaches its maximal size as a minor species on productive soils in moister summer climates, but is most dominant on moister ultramafic substrates. In drier climate regions, the species is restricted to sites with available water in summer, often streamsides.

Port-Orford-cedar has thick bark when mature, and survives multiple surface fires despite being scarred. Its heartwood is strongly decay resistant. It is relatively shade-tolerant. It conifers, up to 5-6 months in some situations. On ultramafic soils, Port-Orford-cedar has higher calcium concentrations in foliage than other conifers. It produces moderate to large seed crops every few years, with less extreme variation and less synchrony among stands than for most conifers. It reproduces well after cutting where there is a seed source. Easy rooting and ability to chemically induce early reproduction make it an easy subject for genetic manipulation. Seed germination requires a relatively high temperature, causing germination in June in the natural range. Its growth rate on productive soils is substantially slower than for Douglas-fir, but is faster than Douglas-fir on ultramafics. The species varies in its foliar and branch structure and color, and substantially in its growth rate, with fastest growing trees from northern, coastal, low elevation seed sources; timing of growth follows the same pattern, with faster-growing trees growing more late in the season than slower-growing families. Late germination and summer-long elongation appear to require the summer-moist sites to which the species is usually restricted.

Port-Orford-cedar has different impacts on the ecosystem than its associated conifers. It appears to maintain Ca cycling on ultramafic soils, perhaps enhancing the soil for growth of other species. It is the only shade tolerant conifer on low-elevation ultramafic sites. Having an unusual combination of fire- and shade-tolerance, it reproduces after fires that only thin the pre-existing stand. Its structure provides habitat for animals, its logs provide much long-lasting structure in streams, and it provides much of the streamside shade in ultramafic areas. Its aesthetic value is high, both in natural ecosystems and widespread cultivated plantings.

Port-Orford-cedar has been cut in large quantities throughout its commercial history, recently primarily for export as logs. The supply has become very limited, and the introduced root rot disease has accelerated the decline of old growth and prevented the regeneration of harvested sites. Efforts to restrict disease spread have failed in some instances, and loss of ecosystem services and aesthetic value in natural forests is widely distributed throughout most of its range.